Handwriting Recognition Using Accelerometer

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Background

Handwriting recognition is the ability of converting intelligible handwritten input from sources such as paper documents, photographs, touch-screens and other devices and then interpret this as text. There are two main types of handwriting recognition based on the way handwriting data is generated: online and offline [1]. In online approach data is collected in real time, that means data is collected while users write. In offline approach data is collected after writing is completed [2]. Online handwriting recognition requires special pen and surface to capture data whereas offline handwriting recognition requires image of handwriting. Online system captures temporal information which helps in achieving better accuracy than offline system. Another advantage of online system is that users and recognizers can adapt with each other to achieve better recognition accuracy. While writing, if the user sees that the character is not recognized by the recognizer, then the user can instantly change the writing style so that the recognizer could further recognize it. Recognizers may also adapt to the writers' writing styles by storing sample characters of the writers [2].

This poster deals with the online approach for recognizing handwriting. In our approach, we have used some learning algorithms by which we can improve our solutions.

Motivation and Problem Formulation

Nowadays, recognizing handwriting perfectly and accurately is important because the use of handwriting recognition technology is becoming a standard not only for mobile devices, but for other equipment as well.

PDAs, laptops, tablets, and mobile phones are some of the digital devices which make use of handwriting recognition in their operation.

Fig1: Some devices which uses handwriting recognition in their operation

Fig2: Stylus

Stylus, a major handwriting recognition device, use capacitive sensing as their main sensor for sensing movement and acceleration for recognizing handwriting.

While writing, the motion of the hand is important to recognize the characters. Therefore, by gathering the information of the hand's movement, one can easily recognize handwriting. We use accelerometer as movement detecting sensor in our approach to detect handwriting. Subsequently, the data found from the accelerometer will be processed by learning algorithms.

Proposed Methodology

An accelerometer gives as output acceleration on three axes. We propose to take the values of these accelerations while writing each character of the English alphabet and label them manually. After procuring significant amount of data, we apply different standard learning algorithms to identify the characters from the acceleration data.

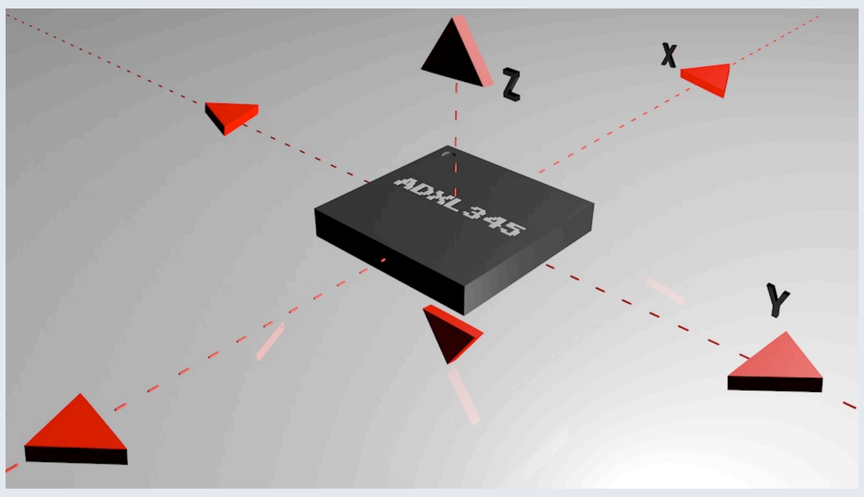

Fig3: *Axes of measurement for a triple axis accelerometer*

Experimentation

For our experiment, we have attached an accelerometer with a pen. Then, we have used this pen for writing characters. At the time of writing, the attached accelerometer provides data for acceleration on X-axis and Y-axis. Actually we have got too many such acceleration data for a single character (for the writing time span of a single character). We have collected such data for several characters from the English alphabet set. Hence, we have applied different learning algorithms on the collected data to build a probabilistic model. Subsequently, we have validated our probabilistic model with 10-fold cross validation. Finally, we have found some promising result in some cases.

Findings

Classifier Name	Accuracy	TP Rate	FP Rate	Precision	Recall	F-measure
NaiveBayes	68.86%	0.629	0.062	0.643	0.629	0.62
AdaBoostM1	22.86%	0.229	0.129	0.162	0.229	0.148
DecisionStump	22.86%	0.229	0.129	0.162	0.229	0.148
RandomForrest	41.43%	0.414	0.098	0.401	0.414	0.394
RandomTree	21.43%	0.214	0.131	0.228	0.214	0.218

- The NaiveBayes classifier gives very high rate of accuracy
- The RandomForrest classifier gives moderate level of accuracy
- AdaBoostM1. DecisionStump, RandomTree give very low level of accuracy
- The low level of accuracy of various models is most likely due to low volume of experimental data

Conclusion and Future Work

As has been seen from our experimental result that, our approach holds merit for recognizing handwriting. We have worked with a very limited set of data in the experiment. By analyzing experimental results, it is worth mentioning that if we use larger data set, then the accuracy of handwriting recognition would be even better. Moreover, we have experimented and analyzed our results on the basis of two-axes data: X-axis and Y-axis. Our future works is to incorporate the third axis, Z-axis so that we could improve our accuracy.

References

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